BRIDGE SITE ANALYSIS

POPLAR - BROCKTON AREA

MISSOURI RIVER

RICHLAND and ROOSEVELT COUNTIES

Prepared by

STATE HIGHWAY COMMISSION OF MONTANA

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BRIDGE SITE REPORT
BROCKTON-POPLAR VICINITY
MISSOURI RIVER

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INTRODUCTION

Some time ago consideration was given to a bridge site, on the Missouri River, almost due south of Poplar. A report, dated November 1948, prepared by the Planning Survey Division of the State Highway Department, discussed the construction and economic aspects of the above mentioned site and a site one mile west and three miles south of Brockton. This report will not discuss, aside from this paragraph, the former site but will discuss the latter. The former site has been dropped from consideration because of (a) the influence of Brockton as a trading center to its potential patronizers, (b) the peculiar, but natural, meanderings and behavior of the Missouri River in that immediate area. Considerable concern has developed that a sudden change in the course of the river, where there are narrow necks between bends or loops, might leave a bridge without a river. The site near Brockton, known herein as the "Rocky Point Site", retains consideration because it is the site selected by the State Highway Department, in pursuance of 1947 Legislation, as possessing the best foundation and other construction features as well as providing reasonably sound assurance that the river would continue, into the foreseeable future, to flow under the bridge - not somewhere else. This assurance is not evident at any other site in the Poplar-Brockton area. This report, therefore, continues and will discuss the Rocky Point site as well as two others.

LOCATIONS

This report concerns three proposed bridge sites in the vicinity of Brockton and Poplar and on the Missouri River.

Site No. 1 is approximately on the section line between Sections 25 and 26, T. 27 N., R. 51 E. It is five miles east and three miles south of Poplar. A site close to that location appears to express the acceptance of people living in Poplar - to the extent that such expresses the maximum distance to the east from Poplar.

Site No. 2 is at the approximate center of Section 29, T. 27 N., R. 52 E. This site is about six miles (on U.S. 2) west and three miles south of Brockton. It expresses the maximum distance to the west acceptable to Brockton residents.

Site No. 3, also known as "Rocky Point Site", is in or close to the northeast corner of Section 12, T. 27 N., R. 52 E. This site is about 10.5 miles (on U.S. 2) east, and thence about 3 miles southeast, of Poplar. It is about 3 miles (on U.S. 2) west, and thence 3 miles southeast, of Brockton. By direct lines this site is some 3 miles south and one mile west of Brockton.

FLOW OF WATER

The people who live in this area advise that the flow, or volume of water per second, always has fluctuated, which is a natural happening. They aver, however, that it has been more variable and unpredictable (to them) since Fort Peck Dam was placed in operation. The concensus is that in pre-Fort Peck days high water could be expected in the spring and low water the rest of the year; since that time there has been a constantly changing volume of water flowing in the river. The ferry operator, south of Poplar, states that, in June 1955, he had to build seven different landings for his craft. Another part of this report bears data concerning volume of flow of water in the river.

There is a wide-spread understanding, which appears to be quite reasonable, that once the Garrison Dam reservoir, in North Dakota, downstream from Fort Peck, has been filled the water flow will be consistent and uniform between the two dams and thus in the area under discussion. There are no water courses, except the Milk River, which would, under normal discharge, carry enough water to greatly affect the volume of flow. If the volume of flow could be held at some 12,000 cu. ft. per second it just might be that there would be very little change in channel courses. There is no definite assurance that such will be the case.

TERRAIN

The valley floor, at Sites 1 and 2, is about three-fourths mile wide on the south side of the river and about one and one-half to two miles wide on the north side. This represents land that would, before Fort Peck Dam was in operation, have been flooded during stages of high water. The terrain, on the north side, thence rises gradually to the Great Northern Railway and U. S. Highway No. 2. The land on the south side rises more rapidly (say 3%) for about five miles. At an approximate distance of six miles south there is a bad-land ridge that will involve heavy grading but is not impracticable to cross.

The valley floor at Site 3, Rocky Point, is about 600 feet wide on the north side and there is none on the south side. There is a rise in terrain of about fifteen feet some six hundred feet north of the river bank and thence the land rises gradually but slowly to the railroad and U. S. 2. The terrain on the south side, in the general vicinity of the bridge site, rises abruptly from the river bank to about 300 feet above water. It levels off for some 100 to 500 feet (variable) and then drops rapidly into the course of Charlie Creek. It is a fortunate circumstance that, at this site, there exists a normally dry water course, or coulee, running southerly almost one-half mile to the top of the ridge. This would afford access to a bridge end on a grade approximating seven percent.

APPROACHES

If a bridge in this vicinity must maintain a nagivational clearance of thirty-eight feet it would mean that an exceedingly great volume of earth would be required to build adequate approaches at Sites 1 and 2. A rough estimate would be a fill averaging 15 feet in depth, 30 feet wide on top, 90 feet

wide at the base, and about 2 miles long. This would total about 380,000 cu. yds. of excavation quantities in the approaches alone. A fill approach at Site 3 would be involved on the north side only. It would be about 15 feet in depth, 30 feet wide on top, 90 feet wide at the base and about 500 feet long, aggregating about 20,000 cu. yds. of excavation. The approach on the south side would be, predominately, in cut necessitating excavation that would, under normal construction conditions, be hauled across the bridge to build the fill on the north side. Thus the construction of the north approach should be considered at no cost to the bridge or its approaches. This cost would be included in roadway costs.

RIP RAP

Sites No. 1 and 2 would require, on the upstream side, about one mile of rip rap immediately upon construction. It is further estimated that, if changes in channel courses should develop due to erosion during high water and normal shifting of soil bars, some two or three miles more of rip rap might be needed during the next twenty years. There is, of course, no assurance that rip rap placed on river banks will not be by-passed and nullified by a high level flood. There might be one saving factor to the rip rap problem - the maintenance of a steady, uniform, low volume of water past Fort Peck Dam. This can be accomplished by judicious control, under normal conditions, of the water release facilities. It is, however, unsafe to plan on such an eventuality because there have been, and probably will be again, seasons which will cause a rapid and unusually high volume of water in Fort Peck reservoir. Site No. 3 will not require much rip rap, compared to Sites 1 and 2 - perhaps one-fourth mile - because of the terrain conditions as described heretofore. This should occur only on the initial construction because there is no indication of course changes for the past 50 years, according to heresay by long time residents. Aerial views of the site lead one to believe this heresay to be true.

FOUNDATIONS

Bridge piers, at all sites, will have to be supported by piling, with one possible exception, that being the south pier at Site No. 3.

LENGTHS OF BRIDGE

Preliminary investigations indicate that a bridge at Sites 1 and 2 should be 1306 feet long and that a bridge at Site 3 should be 797 feet long. These lengths should prevail, regardless of height of deck above water line.

HEIGHT OF BRIDGE

It has been a standard requirement, fixed by Congressional action, that bridges over navigable streams must, if a continuous structure, provide 38 feet clearance above normal high water and that the minimum span over the navigable water must provide a horizontal clearance of 350 feet. There are unconfirmed rumors that this required clearance in height and the required clearance between spans might be waived by the U. S. Army Engineer Corps and set at respective minimums of 20 feet and 100 feet in the case of bridges above Garrison Dam.

COST ESTIMATES

Cost estimates are as follows, for 38 feet vertical clearance and 350 feet horizontal clearance, they being the same for Sites 1 and 2:

Site 1 or Site 2

BRIDGE, 1306 feet long	$ 1,250,000
RIP RAP, 1 mile long, initial	200,000
APPROACH, Earth fill, 380,000 cu. yds.	114,000
INITIAL COST, each	$ 1,564,000
RIP RAP, future protection	600,000
Total estimated construction cost (20 years)	$ 2,164,000

Site 3

BRIDGE, 797 feet long	$ 790,000
RIP RAP, 1/4 mile	50,000
Total estimated construction cost	$ 840,000

If the Army Engineers, or other authorities, should permit a design providing 20 feet vertical clearance and 100 foot span clearance, it is estimated that the bridge cost would be reduced 10 percent, that the rip rap costs would be the same as above, and that fill costs would be reduced 10%. Thus a bridge at Sites 1 and 2 would cost $1,439,000 initially, and a bridge at Site 3 would cost $761,000.

ECONOMIC ANALYSIS

In November 1948, an economic analysis of the Poplar-Brockton bridge sites was prepared which reviewed the construction costs estimated revenue from traffic, and the benefits to traffic which would result from the construction of a bridge and connecting roads in this vicinity.

Since the time that this report was prepared, there has been considerable change in the general situation in this region. In view of these changes, it has been considered advisable to prepare a new analysis to reflect conditions as they exist at the present time. The principal changes from the 1948 report as shown below:

1. The 1948 report established the Poplar bridge site at a point to the southwest of Poplar where the original ferry was located. Later investigations have disclosed the unsuitability of a bridge at this point and two other sites have been selected at points between Poplar and Brockton.

2. The 1948 report placed considerable reliance on proposed irrigation projects which were to be established in the bottom land on the south side of the river. It was estimated that, if these projects were to be fully developed, with division of the land into 90 acre units, the population in the trading area south of the river would be approximately doubled. Recent information reveals that there is little possibility that these projects will be developed within the foreseeable future. A possible exception to this statement is the unit directly south of Poplar concerning which there is still some interest. In view of the fact that present regulations provide that an individual may own 160 acres and that a husband and wife may own a total of 320 acres, there is little possibility that the operation of an irrigation project in this vicinity will increase the population materially. Consequently, this analysis is restricted to present development in the trading area.

3. At the time the 1948 report was prepared, it was contemplated that the FAS route, which was located between Fairview and Girard would be extended in a northwesterly direction to connect with the Poplar or Brockton bridge sites and from there to US Highway No. 2. Since that time this FAS route has been extended westward through McCone County to connect with Montana Highway No. 13 between Circle and Wolf Point. This development has the effect of cutting off a section of the southern trading area which had previously been assigned to the Poplar-Brockton region.

The foregoing developments, coupled with a revision of bridge and highway construction costs, have resulted in the need for the preparation of a new analysis. It is also felt that the present analysis is more reliable since it is based on a more complete investigation of feasible bridge sites and costs and economic conditions in this region.

TRANSPORTATION CONDITIONS

The principal cities along US Highway No. 2 were established in the early part of the century as the result of the railroad construction and the opening of this area to homesteading. Those cities, which were located within the boundaries of Fort Peck Indian Reservation, derived most of their trade from the area to the

south of the Missouri River since there was very little private land in the reservation on the north side of the river. In the absence of general highway development south of the river, it was the practice to move the produce and livestock across the river on ferries located near principal shipping centers. The trading areas for Poplar and Brockton covered a large area south of the river at this time.

The construction of bridges over the river near Culbertson and Wolf Point in the early 1930's, and the improvement of connecting highways, produced some diversion of trade from the interior points at Poplar and Brockton; however, the ferries at these points continued to provide suitable service. This ferry service was later disrupted by the construction of Fort Peck Dam which, through regulation of the river flow, made operation of ferries extremely difficult. The Brockton ferry was abandoned and the Poplar ferry is able to operate only intermittently. This disruption of ferry facilities has placed a great economic burden and inconvenience on the residents south of the river.

At the present time, the ferry operates during a period of from 6 to 8 months from spring to fall, depending on river and ice conditions. During this period, the ferry is inoperable for many days because of inadequate or excessive river flow which may strand the ferry or make it necessary to establish new landings. Also, because the ferry must shift its landings frequently, the counties are unable to build a suitable all-weather road leading to the ferry. This condition, coupled with the absence of gravelled roads in the general area south of the river, produces a situation wherein traffic is unable to get to the ferry during wet weather even though the ferry itself may be in operating condition.

The following tabulation illustrates the extent to which the river flow varies:

MISSOURI RIVER FLOW NEAR WOLF POINT BRIDGE
DURING WATER YEAR 1954

Month	Height in Feet		Discharge in Second-Feet	
	Max.	Min.	Maximum	Minimum
October	9.86	8.74	31,600	24,400
November	8.60	3.49	23,900	6,590
December	5.12	2.49	11,000	4,780
January	4.27	2.85	7,500	5,480
February	7.97	5.11	10,200	5,100
March	6.06	4.64	13,900	5,000
April	7.04	3.01	17,300	6,020
May	2.75	2.31	5,980	4,690
June	3.83	2.02	7,730	4,040
July	9.00	1.81	26,000	3,760
August	9.91	6.85	33,000	17,000
September	9.86	6.39	32,700	14,900

Note: Gage height on some winter readings affected by ice.

During the season when the ferry is not operating, there is a period of about two months when no crossing can be made since the ice is not thick enough to support a vehicle. During the remaining time, ice crossings may be made at times when the ice is not affected by the river flow. It is reported that much of the grain is hauled on the ice during the winter months to the shipping points at Poplar and Brockton.

The present ferry is owned and operated by the Poplar Ferry Association. Fees are charged ranging from $.50 to $1.50 per vehicle. Since the three adjoining counties pay for the support of the ferry, residents of these counties pay the foregoing fees for round trips. Residents from other places pay the same fee for a single crossing. The fees are divided between the operator and the association. In addition to the fees, Roosevelt and Richland Counties pay $112.50 per month towards the operation of the ferry, and McCone County pays $75.00 per month for its operation.

The following is a list of the average number of crossings per month during the operating season:

May 1954	299	October 1954	258
June 1954	353	None - November through April	
July 1954	335		
August 1954	245	May 1955	466
September 1954	266	June 1955	906

As shown on the accompanying map, the roads in the trading area south of the river are predominately graded and drained. There are a few low standard unimproved roads, but none that could be classified as gravelled or all-weather roads throughout their length. The roads in the western half of the area are mostly of a clay material and are subject to considerable softening during wet weather. Roads in the eastern half of the area contain small amounts of granular material, but in most instances the material is insufficient to present a load-bearing surface during wet weather. Many of the roads in the area have been brought to a graded standard since 1945.

Most of the roads follow section lines, with some deviation to conform to the rolling terrain. A region of general badlands begins near the Redwater River and extends eastward at a distance of about 7 or 8 miles south of the river and curves in the eastern end towards the Rocky Point bridge site. There appear to be three levels of land in this general area. The first level consists of bottom land adjacent to the river occupying ancient river channels. A short distance from the river the land raises to a bench at a moderate elevation above the river and extends about five miles to the base of the badlands. The badlands consist of a series of eroded bluffs from two to three hundred feet high, and above these bluffs there is an extensive bench of rolling land showing considerable evidence of ice sheet deposition.

AGRICULTURE

Adjacent to the river there are several farms which appear to be intensively cultivated. Most of the land between the bottom lands and the badland bluffs is used for grazing purposes, with some cultivation. The greatest amount of farm land is located on the high bench. This is quite productive land and is divided about equally

between dry-land grain farming and grazing. Much of the land along the stream drainages is used for growing hay. The holdings are quite large and it is reported that, in common with most of the State, there has been a consolidation of farm units through the purchase of adjoining acreages. The area is served by rural power lines, and rural telephone lines are being installed. It is reported that most of the livestock in the region is trucked to Sidney for sale at the stockyards there. Some grain is hauled southward to the branch railroad line between Sidney and Richey; however, most of the grain is hauled northward across the river, if possible, as the wheat brings a higher price on the main line of the railroad.

TRADING AREA

The principal cities in this general area, in order of population are:

Sidney - 3,987; Wolf Point - 2,557; Poplar - 1,169; Culbertson - 779; Richey - 595, and Brockton - 350. These are all 1950 census figures. It is reported that the present population of Poplar is about 2,200 and the population of Brockton is now about 450 people. Wolf Point and Sidney are the respective county seats of Roosevelt and Richland Counties.

Poplar and Brockton are the closest trading centers for the central area south of the river between the Wolf Point and Culbertson bridges. Poplar is a modern and rapidly growing city with most of the facilities for serving the needs of the surrounding area. Facilities include: direct service by railroad and highways; grain elevators; hotels and motels; grade, junior and high schools; armory; two hospitals;public library; theaters; newspaper; bank; natural gas; electricity; airport; several automobile and implement dealers; and the usual service establishments. The agency headquarters for the Fort Peck Indian Reservation is also located in Poplar. The city is the headquarters for oil field operations which are located in a very productive area to the northeast of the city. Much of the city's recent growth may be attributed to the oil field activity.

Brockton has facilities for serving the basic needs of the trade area, but it lacks many of the commercial facilities. It has three grain elevators; direct service by the railroad and highway; a large general store; filling stations; grade and high school; and small service facilities.

In order to define the area which would benefit from the construction of a bridge and connecting roads, an analysis was made of the travel distances from points south of the river to the highway and thence to Poplar and Brockton. It is generally agreed that the Redwater River forms the western boundary of the trading area. Because there is only one bridge crossing this river, and it being inaccessible at times during flood stage, the river forms an effective barrier to free travel. Residents west of this river find travel distances shorter to Wolf Point, and it is doubtful that bridges at any of the three sites would be of advantage to these people. An exception occurs with respect to the residents living in the area immediately south of the Missouri River and west of the Redwater River. These people used to ford the Redwater River on a concrete county ford and use the ferry service to Poplar. This ford was washed out a few years ago, and at the present time, the river may be forded on a rocky bottom at periods of low water only.

The south boundary of the trading area has been established along the Federal Aid Secondary route which extends westward from Fairview via Girard to a point

on FA Route 25 north of Vida. This road is located at about the midpoint between Federal Aid Primary Route 1 (U.S. #2) and Federal Aid Primary Highway No. 51 (Montana #23) between Sidney and Circle. It also provides an all weather road into Sidney, which would have the effect of delimiting the southern portion of the Poplar-Brockton trading area. As shown on the map, the eastern boundary of the trading area has been established along the general vicinity of Charlie Creek. Residents living east of this boundary would generally find it advantageous to travel to Culbertson, Sidney, or Fairview rather than Poplar or Brockton.

PRESENT TRAFFIC

Quarterly traffic counts are taken at strategic points throughout the trading area. In general, the traffic within the area appears to be quite dispersed with no pronounced pattern. The majority of roads carry between 15 and 20 vehicles per day. Slightly higher traffic volumes are shown at the following points:

Road junction near the ferry - 46 vehicles per day
Road junction near the Redwater Bridge - 30 vehicles per day
Junction on central road near eastern limits - 30 vehicles per day
FAS Route 201 (Fairview-Girard Road) near eastern limits - 46 vehicles per day
Road to Richey - 30 vehicles per day
Road to Lane - 24 vehicles per day

These counts are undoubtedly lower than normal because of the state of general isolation that exists in this region.

TRAVEL DISTANCES

The attached map is based on fairly recent aerial photography and field inventory; therefore, it is considered that the number of dwellings shown and their locations are quite accurate. In order to determine the extent of benefits which would accrue to the residents of the trading area, it was decided to count the number of dwellings in the area and to compute their travel distances to Poplar and Brockton. The results of this analysis are shown in the following table based on a count of 117 dwellings:

	Total Miles	Average Length
To Poplar over Bridge 1	3,018	25.79
" " " " 2	3,321	28.38
" " " " 3	3,896	33.30
To Brockton over Bridge 1	3,500	29.91
" " " " 2	3,041	25.99
" " " " 3	2,958	25.28

The individual trip lengths were distributed as follows:

Trip Length	To Poplar			To Brockton		
	Br. 1	Br. 2	Br. 3	Br. 1	Br. 2	Br. 3
5 - 9	2	0	0	0	0	2
10 - 15	5	3	0	2	6	9
16 - 20	27	8	4	8	20	14
21 - 25	24	35	14	29	30	29
26 - 30	25	21	20	19	33	40
31 - 35	20	34	30	31	19	16
36 - 40	12	13	31	18	9	7
41 - 45	2	3	15	10	0	0
46 - 50	0	0	3	0	0	0
	117	117	117	117	117	117

These travel distances were based on the use of present roads. It is possible that the results would be affected somewhat by the construction of new roads in the general vicinity. It was also necessary to use personal judgment in many instances in selecting the probable routing which residents would use.

The foregoing figures were based on travel distances from all dwellings, regardless of destination or bridge location. It was evident that, depending on bridge location and destination, there would be some residents who would find it advantageous to travel to other trading centers if the bridge were to be located at a point which would involve excessive travel distance. On this premise, it was decided to eliminate all trips over 35 miles in length.

The reduction of trip lengths to 35 miles produced the following results:

	No. of Dwellings	Total Miles	Average Trip Length
To Poplar over Bridge 1	113	2,486	22.00
" " " " 2	101	2,703	26.76
" " " " 3	68	1,971	28.98
To Brockton over Bridge 1	89	2,395	26.91
" " " " 2	108	2,705	25.05
" " " " 3	110	2,697	24.52

It is generally accepted that the attraction of a trading center is in direct proportion to its population and in inverse proportion to the travel distance involved. Applying this formula to the population factor resulted in a weight of 5 for Poplar and 1 for Brockton. When the population was combined with the travel distance, it was calculated that if Bridge 1 were constructed, 100% of the trips would go to Poplar because of its proximity and much greater attraction power. It is realized that there might be a few trips which would have Brockton as the destination, but for practical purposes, it was assumed that all trips would go into Poplar.

It was further computed that if Bridge No. 2 were selected, 80% of the trips would go to Poplar and 20% would go to Brockton. If Bridge No. 3 were selected, 60% of the trips would go to Poplar and 40% would go to Brockton.

The results of the recently completed Motor Vehicle Use Study showed that each dwelling in the open-country rural area generated 687 trips per year. Using this average figure, and dividing the trips to Poplar and Brockton on the basis of the foregoing percentages, there resulted the following figures:

Item	Destination		Total
	Poplar	Brockton	
Bridge No. 1			
Dwellings served	113	- - -	
Annual Trips/Dwelling	687	- - -	687
Total Trips	77,631	- - -	77,631
Average Length	22.00	- - -	22.00
Annual Vehicle-Miles	1,707,882	- - -	1,707,882
Average Daily Traffic			213
Bridge No. 2			
Dwellings Served	101	108	
Annual Trips/Dwelling	550	137	687
Total Trips	55,550	14,796	70,346
Average Length	26.76	25.05	26.40
Annual Vehicle-Miles	1,486,518	370,640	1,857,158
Average Daily Traffic			192
Bridge No. 3			
Dwellings Served	68	110	
Annual Trips/Dwelling	412	275	687
Total Trips	28,016	30,250	58,266
Average Length	28.98	24.52	26.66
Annual Vehicle-Miles	811,904	741,730	1,553,634
Average Daily Traffic			159

To summarize the results of this table:

> Bridge No. 1 would be most favorable, serving 77,631 trips per year with an average length of 22.00 miles, and would carry 213 vehicles per day.
>
> Bridge No. 2 would be the second most favorable, serving 70,346 trips per year with an average length of 26.40 miles, and would carry 192 vehicles per day.
>
> Bridge No. 3 would be the least favorable, serving 58,266 trips per year with an average length of 26.66 miles, and would carry 159 vehicles per day.

In order to compare the benefits which would result from each bridge, it is necessary to make an estimate of the monetary value of the savings which would accrue to the residents as a result of shortened travel distances. To accomplish this, it was decided to compare each bridge with a hypothetical bridge which would serve all 117 dwellings in the trading area. As explained previously in the report, the

travel distance for each dwelling was measured over each proposed bridge to both Poplar and Brockton. Depending on the location of the bridge and the destination of the trip, the average travel distance ranged from 25.28 miles to 33.30 miles. The average of all trips for the entire area was 28.10 miles.

It is possible to compute the value of the estimated savings in travel distance by using this figure of 28.10 miles per trip as the norm for the trading area. The savings in vehicle miles per year is shown below:

Bridge No. 1 (VM = vehicle miles)

Average trip for area	28.10	
Average trip for Bridge 1	-22.00	
Miles saved per trip	6.10	x 77,631 trips = 473,549 VM/Year

Bridge No. 2

Average trip for area	28.10	
Average trip for Bridge 2	-26.40	
Miles saved per trip	1.70	x 70,346 trips = 119,588 VM/Year

Bridge No. 3

Average trip for area	28.10	
Average trip for Bridge 3	-26.66	
Miles saved per trip	1.44	x 58,266 trips = 83,903 VM/Year

The Motor Vehicle Use Study showed that 63% of the trips from a rural dwelling were made by passenger cars and the remaining 37% of the trips were made by trucks. A recent report published by the American Association of State Highway Officials has assigned values to operating and time costs for passenger cars traveling on various types of road surfaces and under different conditions. Similar figures are not listed for trucks, but for the purpose of this analysis, it is believed that truck costs would be about twice those of passenger cars. The construction of any of the proposed bridges will also require construction of approach roads and connecting FAS roads. The northern ends of the routes probably would carry sufficient traffic to warrant oiled surfaces. The remainder of the FAS road probably would be built to a gravel standard. It is likely that the connecting county roads would remain in their present unsurfaced condition.

Since it is impractical to determine the exact travel route for each dwelling, the decision was made to use the figures for gravelled roads as representing an average of the surface types. Being that the same figures are used for each bridge routing, the relative rating for each bridge site would not be affected regardless of the figures used.

The computation of savings to the residents in the trading area is shown in the following table:

	Passenger Cars	Trucks	Total
BRIDGE NO. 1			
1. Percent of Vehicle-Miles	63	37	100
2. Number of Vehicle-Miles Saved	298,336	175,213	473,549
3. Operating Cost per VM	$ 0.0422	$ 0.0844	$ 0.0578
4. Operating Savings (2x3)	$ 12,590	$ 14,788	$ 27,378
5. Time Cost per VM	$ 0.0497	$ 0.0994	$ 0.0680
6. Time Savings (2x5)	$ 14,827	$ 17,416	$ 32,243
7. Total Savings Per Year	$ 27,417	$ 32,204	$ 59,621
BRIDGE NO. 2			
1. Percent of Vehicle-Miles	63	37	100
2. Number of Vehicle-Miles Saved	75,340	44,248	119,588
3. Operating Costs per VM	$ 0.0422	$ 0.0844	$ 0.0578
4. Operating Savings (2x3)	$ 3,179	$ 3,735	$ 6,914
5. Time Cost per VM	$ 0.0497	$ 0.0994	$ 0.0680
6. Time Savings (2x5)	$ 3,744	$ 4,398	$ 8,142
7. Total Savings Per Year	$ 6,923	$ 8,133	$ 15,056
BRIDGE NO. 3			
1. Percent of Vehicle-Miles	63	37	100
2. Number of Vehicle-Miles Saved	36,708	21,558	58,266
3. Operating Costs per VM	$ 0.0422	$ 0.0844	$ 0.0578
4. Operating Savings (2x3)	$ 1,549	$ 1,819	$ 3,368
5. Time Cost per VM	$ 0.0497	$ 0.0994	$ 0.0680
6. Time Savings (2x5)	$ 1,824	$ 2,143	$ 3,967
7. Total Savings Per Year	$ 3,373	$ 3,962	$ 7,335

This table shows that the annual savings to the residents of the trading area would be as follows:

Bridge No. 1	$ 59,621.00 per year
Bridge No. 2	15,056.00 per year
Bridge No. 3	7,335.00 per year

It should be pointed out that these savings show only the relative merit of the three bridges. No attempt has been made to compute the value of all benefits to the residents of the area. To accomplish this would require a complete record of each and every trip taken by each resident of the area. These trips would then have to be compared with the probable trips taken over the bridge routings in order to determine the savings in time and distance that would result. There are also many other benefits which would be realized, such as ability to get the children to school, prompt access to medical, hospital, and recreational facilities, etc., cannot be measured in monetary values.

The analysis to this point shows that INSOFAR AS RESIDENTS OF THE TRADING AREA ARE CONCERNED, BRIDGE SITE NO. 1 WOULD PROVIDE THE GREATEST BENEFIT.

Another point which must be considered is the relationship of the benefits to the cost of the three structures and their essential connecting roads.

It is presumed that any bridge, which may be constructed in this area, will require the designation of a Federal Aid Secondary Route. To meet the immediate needs, it will be necessary only to build a bridge and the necessary roads to connect U. S. Highway No. 2 with a suitable county road on the south side of the river. An overpass will also be required for the crossing of the railroad tracks. It is believed that the volume of traffic on the north end of the route will justify an oiled surface To achieve greatest value, the FAS route should be continued in a general southward direction, on alignment which will serve the most residents, to a point on FAS Route 201. This route extends westward from Fairview via Girard to a point on Montana Highway No. 13 north of Vida. This section of the route should require only a gravel surface during the initial period.

Estimated construction costs of the bridge and connecting roads are shown in the following table:

ESTIMATED CONSTRUCTION COSTS

Section	Bridge No. 1		Bridge No. 2		Bridge No. 3	
US #2 to bridge fill						
Railroad overpass		$ 140,000		$ 140,000		$140,000
Roadway (Grade,gravel,oil)	1.5 Mi	60,000	1.5 Mi	60,000	3.0 Mi	120,000
Bridge and fill	2.0 Mi	1,364,000	2.0 Mi	1,364,000		790,000
Initial rip rap	1.0 Mi	200,000	1.0 Mi	200,000	0.3 Mi	50,000
Future rip rap	3.0 Mi	600,000	3.0 Mi	600,000		- - - -
Roadway to county road (Grade, gravel, oil)	1.5 Mi	60,000	1.5 Mi	60,000	3.0 Mi	158,000
Subtotal - Bridge and connecting roads		$2,424,000		$2,424,000		$1,258,000
Subtotal - Roadway length		5.0 miles		5.0 miles		6.0 miles
Connecting road to FAS Route 201	11.0 Mi	275,000	11.0 Mi	275,000	19.0 Mi	526,000
GRAND TOTAL COST		$2,699,000		$2,699,000		$1,884,000
Roadway Length		16.0 miles		16.0 miles		25.0 miles

The locations of the probable FAS routes are shown on the attached map. These will connect with FAS Route 201 at the south end and also connect with county trunk roads leading to Montana Highway No. 23 in the vicinity of Richey or the Lane-Enid area.

The total cost of the construction items has been reduced to an annual cost on the basis of the following service lives:

Construction Item	Bridge No. 1 Service Life	Bridge No. 1 Annual Cost	Bridge No. 2 Service Life	Bridge No. 2 Annual Cost	Bridge No. 3 Service Life	Bridge No. 3 Annual Cost
Bridge and overpass	40 years	$37,600	40 years	$37,600	40 years	$23,250
Rip rap, fill and connecting roads	20 years	46,000	20 years	46,000	20 years	16,400
SUBTOTAL - BRIDGE AND ESSENTIAL CONNECTIONS		$83,600		$83,600		$39,650
Remainder of FAS route	20 years	13,750	20 years	13,750	20 years	27,684
GRAND TOTAL		$97,350		$97,350		$67,334

This table shows that Bridge No. 3 and connecting roads would be the MOST FAVORABLE FROM THE STANDPOINT OF CONSTRUCTION COSTS.

In order to appraise the overall merit of each bridge and its connecting roads, it is necessary to compare the amount of annual construction costs with the value of the annual benefits or savings. This comparison is shown below:

Item	Bridge No. 1	Bridge No. 2	Bridge No. 3
BRIDGE AND ESSENTIAL CONNECTIONS:			
Annual Costs	$ 83,600	$ 83,600	$ 39,650
Annual Benefits	59,621	15,056	7,335
Benefits/Costs	0.7131	0.1800	0.1849
ENTIRE ROUTE:			
Annual Costs	$ 97,350	$ 97,350	$ 67,334
Annual Benefits	59,621	15,056	7,335
Benefits/Costs	0.6124	0.1546	0.1089

THE COMPARISON OF ANNUAL COSTS TO ANNUAL BENEFITS SHOWS THAT BRIDGE SITE NO. 1 HAS THE MOST FAVORABLE OVERALL RATING.

This analysis has been confined to an appraisal of the traffic and benefits pertaining to the residents living within the defined trading area south of the Missouri River. There are other factors which, although they would have little effect on the results of the analysis, should be mentioned in connection with the estimated future traffic.

It is quite definite that there will be some additional traffic which will originate in the cities of Poplar and Brockton and other points of proximity and which will add to the traffic on any of the proposed routes. Examples of this type

of traffic includes deliveries of gasoline, furnace fuel, farm supplies, mail, and other commodities. There will also be school bus routes established across the river to carry the children to the better facilities available in Poplar and Brockton. This will apply especially to the high schools.

Bridge Sites 2 and 3 will be so located that there will be a small amount of traffic on the north side of the river which will be able to use the proposed routings. Unless there is some additional county road construction in this vicinity, it does not appear that Bridge Site 1 will be of any benefit to local residents between the river and U. S. Highway No. 2.

It is estimated that the additional traffic which would be generated from sources other than the residents of the trading area would amount to about 15% of the traffic from the trading area. There is also a possibility that there would be some use of these routes, when constructed to a suitable standard, by through traffic. An allowance of 20 vehicles per day is included for this type of traffic.

The addition of this type of traffic to the basic traffic generated in the trading areaincreases the estimated present potential traffic to the following:

	Average Daily Traffic	Annual Trips
Bridge No. 1	265	96,581
Bridge No. 2	241	88,298
Bridge No. 3	203	74,388

Since the service life of the bridge and overpass are estimated at 40 years, and the life of the roadway and other features are estimated at 20 years, it is necessary to estimate the amount of traffic increase which would occur during a 30 year period. It is estimated that the average increase during this period would amount to 50%. Application of this percentage to the foregoing figures results in the following:

	Average Daily Future Traffic	Annual Future Trips
Bridge No. 1	398	144,872
Bridge No. 2	362	132,447
Bridge No. 3	305	111,582

The estimated cost per crossing for each bridge site is computed by dividing the above figures into the annual cost of the bridge and its essential connections. These computations follow:

	Annual Cost	Annual Trips	Cost Per Trip
Bridge No. 1	$ 83,600	144,872	$ 0.5770
Bridge No. 2	83,600	132,447	0.6311
Bridge No. 3	39,650	111,582	0.3553

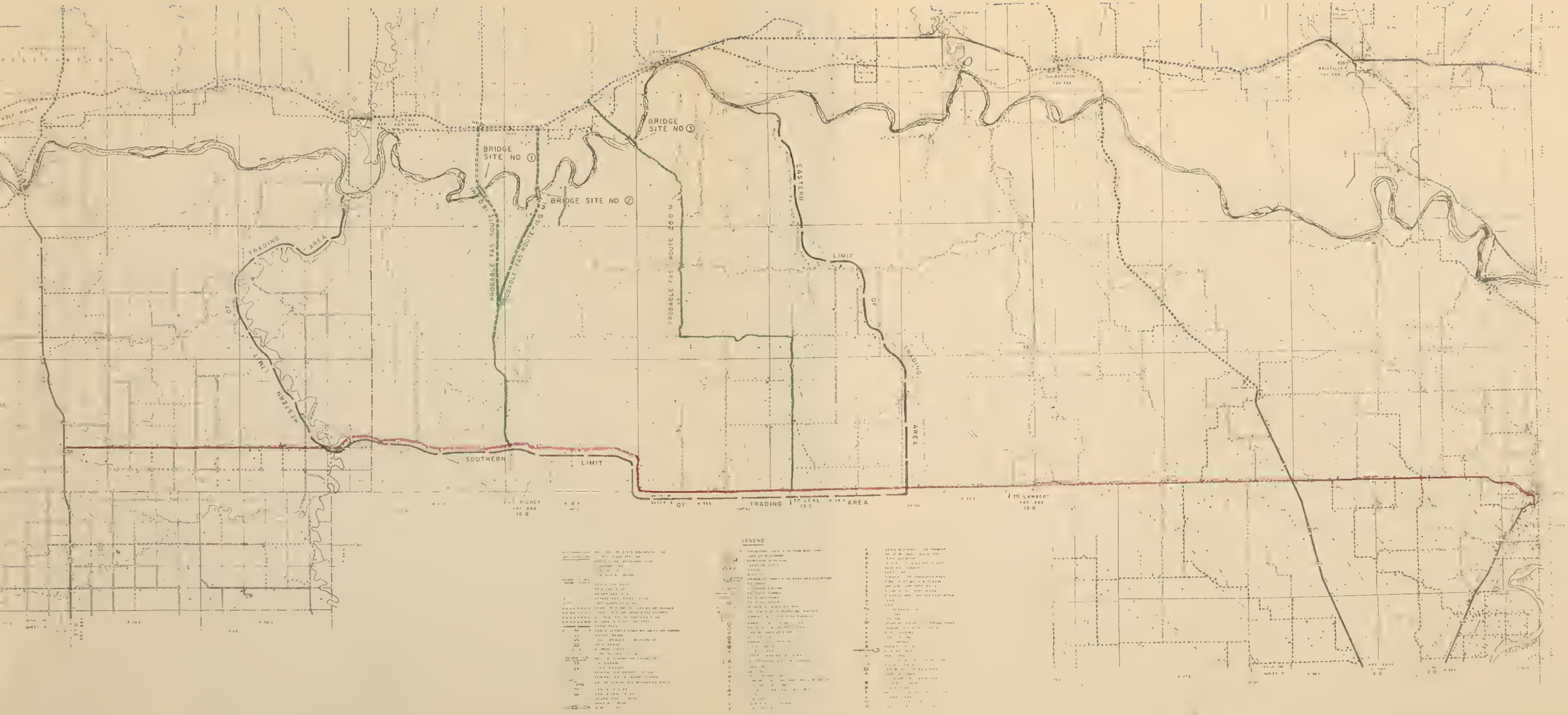
The analysis would not be complete without some reference to the distribution of costs involved in the construction of the bridge and the connecting roads. That portion of the bridge and connecting roads north of the main channel of the Missouri River will probably be located entirely on non-patented Indian land. In accordance with present practice, the cost of this portion of the construction may be paid entirely out of Federal Aid funds. In this case the disbursement would be from Federal Aid Secondary System funds. On this basis, it appears that there would be no charge to secondary funds allocated to Roosevelt County in accordance with State law.

The portion of the bridge and roadway south of the main channel of the river is outside the Indian reservation, and as such it would have to be financed with Federal Aid and State funds in the regular 57-43 matching ratio. This section of the route is located in Richland County and any State funds would have to come out of that county's apportionment of secondary funds.

The latest report is that about $90,000.00 has been pledged by interested parties to assist in the financing of this bridge. It is reported that $40,000.00 of this amount will be paid by the two counties involved. The remainder consists of private subscriptions which are supported by cash in escrow or promissory notes. It is possible that some of this private money will be withdrawn if the bridge is not located in a site which is satisfactory to the subscriber. It is felt that the amount of money which has been raised is strong evidence of the great need for a bridge in this vicinity.

If it is assumed that the middle of the river marks the boundary of the Indian reservation on all bridge sites, the total cost of the portion to be financed out of regular Federal Aid and State funds would amount to $1,142,000.00 for both Bridge Routes 1 and 2, and about $578,000.00 for Bridge Route 3. The cost to Richland County from its secondary funds would amount to about $490,000.00 for Bridge Routes 1 and 2 and about $250,000.00 for Bridge Route 3. Of course, any amount of the public subscription funds available could be deducted from this amount.

To summarize, Bridge Route 1 would provide the greatest benefit to the residents south of the Missouri River. Bridge Route 3 would have the lowest construction cost and would have the lowest cost per crossing. Bridge Route 1 would be the most favorable from an overall standpoint since it would provide the greatest benefit for the cost involved. Whether a bridge may be constructed at all will depend to a large extent on the condition that Richland County will allocate its future secondary system construction funds to the financing of the bridge and its connecting roads.



MAP TO ACCOMPANY
ANALYSIS OF

POPLAR-BROCKTON BRIDGE SITES

JULY 27, 1955